Program Review

Pacific Forestry Centre - 1988-89

Forestry Canada Forêts Canada

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Forestry Canada 1989

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Forestry Canada

Forestry Canada is the main focus for forestry matters in the federal government. It provides national leadership through the development, coordination, and implementation of federal policies and programs to enhance long-term economic, social, and environmental benefits to Canadians from the forest sector.

Forestry Canada is a decentralized organization with six regional forestry centres, two national research institutes, and seven regional sub-offices located across Canada. Headquarters is located in the national capital region, in Hull, Quebec.

In support of its mandate, Forestry Canada carries out the following activities:

- Administers forest development agreements negotiated with the provinces.
- Undertakes and supports research, development, and technology transfer in forest management and utilization.
- Compiles, analyzes, and disseminates information about national and international forest resources and related matters.
- Monitors disease and insect pests in Canada's forests.
- Provides information, analyses, and policy advice on economics, industry, markets, and trade related to the forest sector.
- Promotes employment, education, and training opportunities in the forest sector.
- Promotes public awareness of all aspects of the forest sector.

Forestry Canada interacts regularly with provincial and territorial governments, industry, labor, universities, conservationists, and the public through such bodies as the Canadian Council of Forest Ministers, the Forest Sector Advisory Council, the Forestry Research Advisory Council of Canada, the Canadian Forest Inventory Committee, the Canadian Committee on Forest Fire Management, the Canadian Interagency Forest Fire Centre, and regional consultative committees. Forestry Canada is also active in international forestry agencies such as the International Union of Forest Research Organizations and the Food and Agriculture Organization, as well as in technical and trade missions.

Forêts Canada

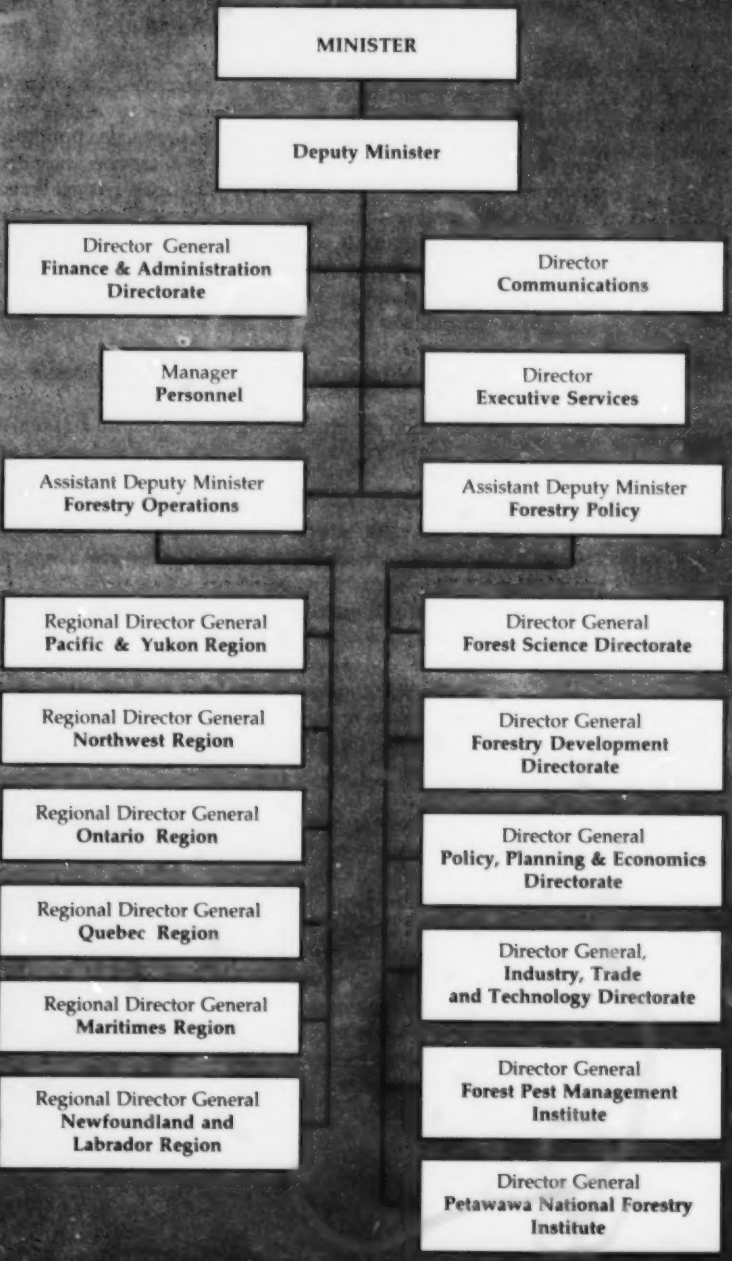
Forêts Canada est l'organisme principal en matière de foresterie à l'intérieur du gouvernement fédéral. Chef de file sur le plan national, il assure la préparation, la coordination et la mise en œuvre des politiques et programmes fédéraux dans le but d'améliorer les avantages économiques, sociaux et environnementaux à long terme offerts aux Canadiens par le secteur forestier.

Forêts Canada est une organisation décentralisée: six centres de foresterie régionaux, deux instituts de recherche nationaux ainsi que sept sous-bureaux régionaux sont répartis dans tout le Canada. Le siège social est établi dans la région de la Capitale nationale, à Hull (Québec).

Pour remplir son mandat, Forêts Canada assume les tâches suivantes:

- il administre les accords de développement forestier conclus avec les provinces
- il entreprend et appuie la recherche, la mise au point et le transfert technologique dans le domaine de la gestion et de l'utilisation des forêts
- il rassemble, analyse et diffuse de l'information sur les ressources forestières nationales et internationales et les domaines connexes
- il fait des relevés des maladies et des insectes ravageurs des forêts canadiennes
- il fournit de l'information, des analyses et des conseils (quant aux politiques) concernant l'économie, l'industrie, les marchés et le commerce reliés au secteur forestier
- il favorise les occasions d'emploi et de formation universitaire et technique dans le secteur forestier
- il encourage les Canadiens à prendre conscience de tous les aspects du secteur forestier.

Forêts Canada entretient des rapports sur une base régulière avec les gouvernements provinciaux et territoriaux, l'industrie, le monde du travail, les universités, les environnementalistes et le public par l'entremise d'organismes comme le Conseil canadien des ministres des Forêts, le Conseil consultatif du secteur forestier, le Conseil consultatif de la recherche forestière du Canada, le Comité de l'inventaire des forêts du Canada, le Comité canadien de la gestion des incendies de forêt, le Centre interservices des feux de forêt du Canada et des comités consultatifs régionaux. Forêts Canada joue également un rôle actif dans des organismes internationaux de foresterie comme l'Union internationale des organisations de recherche forestière et l'Organisation pour l'alimentation et l'agriculture, de même qu'au sein de délégations de nature technique ou commerciale.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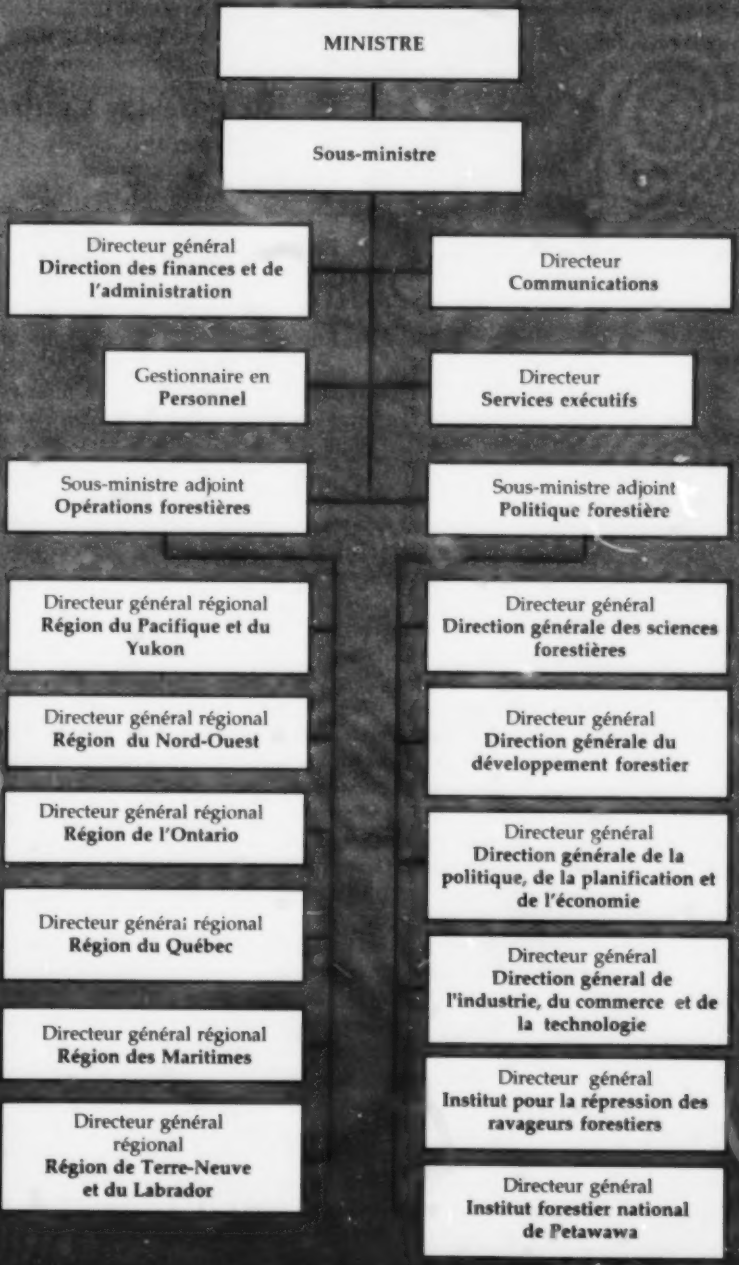
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Pacific Forestry Centre
A word from the Director-General

Dr. John Drew

History will undoubtedly record 1988 as a remarkable year of change and rebirth for the federal forestry service and for forestry in Canada. Gone are the debates of yesteryear suggesting that Canadian forestry might be a "sunset" industry. The facts just did not support this view. The idea just didn't work for the 200,000 Canadians directly employed in forestry, the 300 towns and communities whose lifeblood is forestry, or for those aware of the $40 billion positive net contribution that forestry makes to Canada's trade balance. While visions of the future are crystallizing, I am happy to report that Forestry Canada's commitment is firm: Canada will always be known for the quality of her forests and the vitality of her forest industry.

It was my distinct pleasure early in 1989, to assume the role of Director General of Forestry Canada's Pacific and Yukon regional office and to relocate to the Pacific Forestry Centre. I have much to thank former colleagues in the Alberta Forest Service, where I recently served as Director of Reforestation and Reclamation with Weyerhaeuser Company, who provided many of those formative experiences to equip me for this job. I feel particularly fortunate to have joined federal forestry immediately after it evolved from a service within a department (Canadian Forestry Service reporting to Agriculture Canada) to full departmental status - Forestry Canada. This creation of a full department, emphasizes the federal commitment to forestry, and recognizes its importance to Canada's economic and environmental health.

In order to respond to this new status at a regional level, and to deliver programs tailored to the needs of the region, we at the Pacific Forestry Centre are currently reviewing our strategic plans and studying how our regional organization accommodates the needs and expectations of our various client groups. When plans are complete in mid-to-late 1989, we fully expect to be organized to deliver programs that are both relevant and excellent; supporting the Department on a regional level as it delivers its new mandate, roles and responsibilities.

On the staff side several new people joined the Pacific Forestry Centre during the year under review including: **Dr. Raj Prasad,** a herbicide specialist who transferred from the Forest Pest Management Institute in Sault Ste. Marie;

Dr. Abul Ekramaddoulah, a protein chemist/immulologist from Alberta; **Dr. Mike Heit** as Program Director of Development; **Dr. Doug Pollard**, research scientist, growth and biology; **Tom Bown**, forest ecophysiology technican; **Paul Boudewyn** mensuration technician, and **Rene de Jong**, mensurationist replacing **Eleanor Gardner**, who left on education leave.

Retirements during the year included: **Dr. Holger Brix; Dr. Slavoj Eis; Ed Hopps, Ed Chatelle; Blanche Page, and Harold Hendriksen.**

Dr. Terry Honer returned from a 2-year CIDA assignment and was seconded to the B.C. Ministry of Forests for a year. **Dr. Alan Thomson** left on development leave for one year to the University of Edinburgh. **Al Mitchell** and **Bill White** earned their doctorates during the review period. Three scientists were promoted - **Dr. Jack Sutherland** to a research scientist 4 level and **Jim Arnott** and **Dr. Imre Otvos** to research scientist level 3.

Details on specific project activities and accomplishments are to be found within this publication. There are exciting things happening at the Pacific Forestry Centre and you can expect to hear more from us.

T. John Drew
Director General
March 31, 1989

Forest Growth

D. Pollard

R. J. De Jong

E.R. Gardner

V.G. Marshall

A.K. Mitchell

C. Preston

T. Trofymow

Growth and biology: Douglas-fir ecosystems

Project Leader: Dr. D.F.W. Pollard
Professionals: R.J. De Jong, E.R. Gardner, Dr. V.G. Marshall, Dr. A.K. Mitchell, Dr. C.Preston, Dr. T. Trofymow
Technicians: T. Bown, M. Clayton, C.R. Layton, K. McCullough.

Objectives

Through a balanced program of fundamental and applied research and technology transfer, to improve understanding of tree growth and biological processes of soil and trees in Douglas-fir ecosystems in response to thinning, fertilization and environmental variables. This information will be used in the development of a biologically based mechanistic model for tree growth.

Achievements

Eighteen years after treatment, the second biomass sample entailing 20 trees from each of four main treatments was collected and analysed for dry matter distribution. A unique determination of needle number, weight and area by year of emergence was completed. Equipment for direct measurement of photosynthesis, respiration and transpiration was assembled.

Research continued on thinning and nitrogen fertilization effects on soil chemistry, soil water, soil microflora and fauna and their interrelationships in nutrient cycling and nutrient availability in trees. This, together with with improved understanding of the physiological response of trees to treatments, is the basis for development of a biological model of stand management effects on ecosystem response and stand growth. Priority needs of the model were identified and reviewed.

The 15-year report on growth response was completed.

Reports were published on: effcts of phosphorous and sulfur fertilization, characterization of humic acids, effects of glyphosate on soil biology, application of NMR spectroscopy to organic soils, roots in forest soils, and rates of rhizodeposition and ammonium depletion in the rhizosphere. Research conducted under FRDA and scientific authority of study leaders produced reports on Douglas-fir fertilization decision-making for industrial use, effects of stand density and fertilization on stand development, variability of tree crop response to operational fertilization, and the influence of site quality on tree resource allocation to fine roots. A Ph.D thesis was completed successfully (Dr.A.K.Mitchell), and a M.Sc. course undertaken (E.R.Gardner).

The Shawnigan installation continued to attract the attention of forestry clients, with over 90 visitors representing industry, governments and the scientific community. Groups included stand tending coordinators of BCMF, the International Energy Agency, and Malaspina and New Caledonia Colleges.

Projections

A comprehensive analysis of new data on biomass production and allocation of biomass to its above-ground components will be undertaken to provide a more fundamental understanding of growth response. Weather recording equipment will be updated and existing records analysed to facilitate the evaluation of soil moisture and other vaiables as major determinants of forest growth. N-15 tracer techniques will be applied to the elucidation of transport and transformation of nitrogen in the ecosystem. Information obtained will be incorporated into the SHAWN model which will serve to predict stand tending effects under different site conditions.

Study leaders will investigate ways of extending principles gleaned from the Shawnigan Lake site to operational problems, such as the nutritional deficiencies apparent in certain salal-dominated cutovers, and will include other species of interest to clients. A review of Project objectives for 1990-1995 will take these findings into account.

G.M. Bonnor

R. Alfaro

Y.J. Lee

Forest growth and measurement

Project Leader: Dr. G.M. Bonnor
Professionals: Dr. R. Alfaro, Dr. Y. Lee
Technicians: B. Brown, J. Dronzek, E. Wegwitz

Objectives

In cooperation with other forest agencies, to develop, refine and apply methods of assessing effects of: silvicultural treatments on growth and yield; growth and yield of natural stands; catastrophic depletions due to pests and other causes; and static and dynamic inventories, for the purpose of improving intensive forest mangement practics.

Achievements

Investigations to improve the accuracy of variable density yield tables intensified. Test data analyses revealed the main problem to be poor estimation of stand basal area and diameter from photo measured variables, hence these relationships were targeted for further study.

In growth modelling of Douglas-fir stands in the B.C. Interior, data acquisition was completed and data compilations and analyses, as well as modifications to the FIBER model, were initiated.

Permanent plots to assess impacts of spruce budworm on interior Douglas-fir were remeasured.

A study was completed of the effects of spacing on the damage caused by spruce weevil to Sitka spruce.

Runs of the SWAT computer program (Spruce Weevil Attack Trials) were used by BCMF to calculate impacts of the spruce weevil on the timber supply of the Prince Rupert Forest Region.

Radar and MEIS imagery were acquired and analyzed for clearcut monitoring. A report on the use of Landsat TM data for western spruce budworm monitoring was prepared.

Project staff continued their activities as cooperators in the Levels-of-Growing-Stock (LOGS) study at Shawnigan Lake and Sayward Forest. This range-wide mensurational study of Douglas-fir growth response to several levels of thinning is now into its 20th year in the Vancouver Island study areas.

Data from permanent sample plots near Watson Lake in the Yukon were collected and analysed, and a report was produced. Volumes in the spruce and

pine stands range up to 223 m^3/ha.yr, and growth rates up to 2.7 m^3/ha.yr. Also in the Yukon, plans for establishing a permanent sample plot data base were initiated.

Under a Canada-Mexico Memorandum of Understanding, advice on growth and yield measurement procedures was provided to Mexican foresters.

Through the Technical Advisory Committee of the provincial Productivity Councils, service to and contact with other provincial growth and yield agencies was also maintained.

Five research papers were published.

An international symposium on insects affecting reforestation was organized and proceedings published.

Projections

In cooperation with the Inventory Branch of the B.C. Ministry of Forests, the accuracy of existing yield tables will be tested.

The Interior Douglas-fir data will be used to assess the influence on growth rate of site quality, harvesting method, stand density and other factors.

With assistance from the Forest Productivity Councils and the Kamloops Forest Region, a computer model will be developed to incorporate budworm impacts into stand projection systems.

Data will be collected to calibrate the SWAT model for the Prince George Forest Region.

Acquisition and analysis of MEIS data for root disease damage will be continued.

Participation in LOGS and in the Technical Advisory Committee will be continued.

A.J. Thomson

H.J. Barclay

Systems studies in forestry

Project Leader: Dr. A.J. Thomson
Professionals: Dr. H.J. Barclay

Objectives

To evaluate the effects of selected pests and forest management practices on tree and stand growth, and develop elements of models and management systems.

Achievements

Simulation and mathematical models of pest population dynamics and impact have been developed for a range of forest pests, notably the mountain pine beetle, in B.C. The models are used to assess the feasibility and effectiveness of integrated pest management and forest management practices. The primary user of such systems is the British Columbia Forest Service. In addition, an expert system for diagnosis and treatment of nutrient deficiencies in Sitka spruce plantations has been developed in collaboration with the United Kingdom Forestry Commission, and a growth and yield analysis system developed for a local forest industry. The systems are described in a range of publications.

Projections

The existing systems will be refined as performance evaluations and validations are carried out, and new systems developed to meet the changing needs of our clients. Expert systems will be increasingly used to provide a unique form of technology transfer, bringing research results to users in a concise and integrated manner.

J.T. Arnott

D.G.W. Edwards

D.E. Macey

Seeds, nurseries and regeneration

Project Leader: J.T. Arnott
Professionals: Dr. D.G.W. Edwards, D.E. Macey
Technicians: D. Beddows, G.J. Goodmanson, F.T. Portlock and D.W. Taylor

Objectives

To develop, evaluate and enhance tree seedling production and establishment methods. To enhance the quality and quantity of forest tree seed supply in B. C. and the Yukon, by developing improved methods for forecasting, procurement, processing, utilization and certification of seeds. To administer international schemes for seed certification (OECD), seed sampling and testing (ISTA).

Achievements

Long-term study of tree growth in 15 to 20-year-old Coastal plantations of container seedling origin continues within this project. Results confirm that biological and economic gains can be realized over the longer term with the styroblock reforestation system compared to conventional bareroot reforestation methods.

High elevation species and stock type trials, run in cooperation with the B. C. Ministry of Forests continue to be measured biannually, and results demonstrated to regional staff with on-site field tours. Tenth-year growth measurements indicate that noble fir and Engelmann spruce show much promise as exotics for introduction to the montane ecosystems of Vancouver Island.

Photoperiod research in container seedling nurseries indicates that a one- or two-hour break of supplemental light in the middle of the dark period is as effective as conventional daylength extension in promoting shoot growth of long-day species. Operational demonstrations of the technique are continuing.

The impact of drought stress versus short-days as a means of controlling the shoot growth of western hemlock and western redcedar in container seedling nurseries was studied in cooperation with University of Victoria, B.C. Research and MacMillan Bloedel Ltd. via federal FRDA contracts. The impact of these nursery cultural treatments on subsequent field performance of the seedlings is being investigated cooperatively by all three agencies. Results to date were presented in three papers given at the combined meeting of the Western Forest Nursery Associations in Vernon, B.C. in August, 1988.

A trial to test the operational use of the IDS (sink/float) seed sorting method was undertaken in cooperation with BC Ministry of Forests and Simon Fraser University, and project staff were involved in the production of some specialized equipment for applying the IDS method to operational quantities of seeds. A survey of approximately 100 seedlots of white and Engelmann spruce was begun (with funding provided by the FRDA program) to determine which would benefit most from large-scale application of the IDS process. A report of a collaborative study (with Canadian Pacific Forest Products) on the effects of flowering phenology, cone collection and storage treatment, and seed pretreatment in a Douglas-fir seed orchard was published in the Journal of Forest Ecology and Management. Further studies on the effects of water-spray cooling treatment and supplemental-mass-pollination on seed yield, seed genetic quality and germination are underway.

Certificates representing more than 1500 kg of tree seeds to be marketed internationally were issued under the official seed certification (OECD and ISTA) program. The "Forest Tree Seed Inspector's Manual" was published as Forestry Canada Info. Rep. DPC-X-22. Other related publications include "Forest tree seed certification in Canada: 1981-1985 Summary Report", Forestry Canada Info. Rep. BC-X-299 and "Guidelines for labeling and grading tree seeds in Canada", Forestry Chronicle 64:334-344. Project staff represented Canada at the biennial meeting of Designated Authorities under the OECD seed certification scheme in Paris, France.

New research towards a better understanding of the biochemical, physiological and developmental basis of growth and differentiation in container-grown stock in response to cultural and environmental parameters was initiated. Correlative studies relating endogenous hormone dynamics to physiological and developmental processes during seed germination, shoot elongation and bud development was begun.

Projections

To conduct more basic research on the impact of nursery cultural regimes on the morphological and physiological development of container-grown seedlings, and to evaluate how these parameters affect the success of tree seedling establishment in the field. Tissue culture technology will be used as a vehicle for understanding the physiology of shoot development and its regulation at the tissue and cellular levels.

To continue long-term monitoring of species and stock type trials already established.

To develop the IDS seed sorting method for use on an operational scale. and to improve and refine methods for overcoming seed dormancy in western white pine and yellow cedar.

The seed, nursery and regeneration research project will be amalgamated with the Forest weed control strategies project in 1989/90 under the new project title "Forest Renewal".

B.D. Lawson

B.C. Hawkes

S.W. Taylor

Fire research

Project Leader: B.D. Lawson
Professionals: B.C. Hawkes, S.W. Taylor
Technicians: G.N. Dalrymple, M.A. Grismer

Objectives

To develop fire behavior prediction systems for major fuel types, and to incorporate this knowledge within the Canadian Forest Fire Danger Rating System (CFFDRS), a national framework designed to assist fire management agencies with forest resource protection. To develop methods and models to incorporate fire effects knowledge into land management practice, in order to improve the application of prescribed fire to a variety of silvicultural problems.

Achievements

Work continued on the CFFDRS's Fire Behavior Prediction (FBP) System, a cooperative effort by the Forestry Canada (ForCan) Fire Danger Group. Two meetings were held to further develop the fuel consumption and crown fire algorithms for the 14 fuel types presently in the FBP system. Two papers were co-authored on the CFFDRS for an Australian conference on bushfire modeling and in the Forestry Chronicle. Planning continued with the B.C. Forest Service on a major study of fire behavior in key benchmark fuel types for B.C. including air tanker effectiveness assessment procedures related to the fire intensity outputs of the FBP system.

Field studies of spruce-balsam logging slash fuel moisture wetting and drying rates were continued for a second year to test existing model assumptions for medium slash and test hypotheses for large slash moisture model formulation. Results of the medium slash study were presented at the 10th Fire and Meteorological conference in April, 1989.

Prescribed fire research at PFC continued in several fronts. Work continued under the FRDA cost-shared and federal component sub-programs with several studies led or supervised by the PFC fire research unit. Seedlings were planted on the intensive, long-term prescribed fire study near Prince George completing the establishment phase of the study with first season growth measurements taken. Post-treatment vegetation, soils, micro-climate measurements were completed and an establishment report written. More operational burns were monitored under a companion study on the use of fire for rehabilitating backlog areas.

The Fire Research Unit managed several contract studies in prescribed fire during the year. Fire treatments were monitored in a study of spraying and burning by UBC's Forestry Faculty (M. Feller). Prescribed fire effects are being addressed in two studies by UBC's Soil Science Dept. (T. Ballard and M.

Curran) and MacMillan Bloedel Ltd. (W. Beese) with reports nearing completion. A previous study of prescribed fire effects on growth and nutrition of planted white spruce by T. Ballard was published by ForCan at PFC.

A cooperative B.C. Forest Service, forest industry, and ForCan study was initiated into the development of an expert system for prescribed fire decision-making. A prototype was developed and feedback obtained from experts in this area. A meeting of the ForCan Prescribed Fire Group was held in Victoria and progress made on items listed in a strategic plan for the group. A data base of prescribed fire behavior and fuel consumption was initiated for coastal fuel types in B.C. with data from US and Canada. On the national scale, the PFC Fire Research Unit assisted with a new study of large-scale prescribed fire emissions and smoke dispersal led by Great Lakes Forestry Centre in cooperation with scientists from several US agencies.

The 1988 meeting of the Northwest Fire Council was held in Victoria with the PFC Fire Research Unit taking a lead role in organizing the program and accommodation logistics.

Projections

Completion of the FBP System For. Tech. Rep. draft in 1989 with a Fire Danger Group - sponsored national information session. Finalize planning for B.C. - based field fire behavior study in identified benchmark fuel types. Complete analysis and additional reporting of two years of field test data collection on medium and large diameter slash moisture.

The FRDA prescribed fire work will continue with second year measurements on vegetation and tree growth response to treatments and other cooperative studies on micro-climate and nutrient effects. Additional operational backlog burns will be monitored to assist in prescription model development. Final FRDA reports will be published for both studies.

On the national and international scale, the PFC Fire Research Unit will continue to cooperate on the large-scale prescribed fire emissions and smoke dispersal study led by the Great Lakes Forestry Centre in Ontario. Cooperation with provincial agencies on a smoke management study in B.C in 1989 is being discussed.

R.B. Smith

E. Hetherington

Carnation Creek fish/forest interaction

Project Leader: Dr. R.B. Smith
Professionals: Dr. E. Hetherington
Technicians: R.K. King, R.J. Rowswell

Objectives

To conduct forestry, hydrology, vegetation and soil studies at Carnation Creek for use in the development of appropriate forest harvesting practices for coastal salmonid-producing watersheds.

Achievements

In March, 1989, Dr. Hetherington undertook a two-week training period with Hydrocomp in California to test, calibrate and learn the use of the HSPF hydrology computer model. Carnation Creek hydrometeorological data is the basis for testing and calibration.

A paper on the history of the Carnation Creek Watershed Project was co-authored with J.C. Scrivener (PBS) and presented at the 1988 Canadian Hydrology Symposium. Another on forest watershed studies in the southern interior of B.C. was co-authored for the same symposium.

Data collection at the steep slope, subsurface stormflow and fog-drip precipitation study site continued for the 6th year. Summer monitoring of valley bottom groundwater levels was conducted for the 13th year and two sites were monitored over the winter period.

Several small computer programs were written to manipulate slope hydrology and hydrometeorological data and a major one developed for digitizing charts on the PFC digitizer.

The 10th-year revegetation assessments were completed for 21 plots. A FRDA contract (Hays), which included multivariate analyses on some of the 5th-year data, was completed. Elements of this report have been used in planning analysis of the 10th-year data.

Projections

Further subsurface flow measurements and experiments will be conducted at the main plot and tracer measurements at three other sites. Summer valley bottom groundwater levels and fog-drip precipitation will continue to be monitored.

The HSPF hydrology computer simulation model will be installed on the PFC VAX computer and testing and calibration with Carnation Creek data continued. Assistance will be provided to Dr. R.P. Swanson (NFC) in facilitating use of the model across Canada.

The 10th-year assessment will be made on 74 revegetation plots, of which 52 are 5 years post-herbicide. A 5th-year assessment will be done on an additional 39 plots established only for the herbicide trial. All plots will be stratified on the basis of an original landform/soil/vegetation classification as one of the bases for summarizing vegetation development.

R.B. Smith

P.R. Commandeur

J.P. Senyk

Environmental impact of forestry practices

Project Leader: Dr. R.B. Smith
Professionals: P.R. Commandeur, J.P. Senyk,
Technicians: J. Dronzek, R.J. Rowswell, E.F. Wass

Objectives

To identify, measure and explain the effects of harvesting, site preparation and stand tending practices on forest environments and productivity and to use this information to identify and support existing good practices and lead to the development of new practices where required.

Achievements

Survival, condition, diameter and height were determined for all trees in the soil-disturbance plantations at Golden, Clearwater and Shawnigan Lake. Analyses of 5-yr results from the Vernon and Phoenix stumping-disturbance plantations were completed and a draft report prepared. Soil analysis was continued for the three younger plantations and summaries and statistical analysis of height, diameter and volume carried out following the fall/88 measurements.

First-yr assessment of planted seedlings in the coastal ground skidding site were completed. Dead seedlings were replaced with 1-0 western hemlock plugs and root-growth capacity and root-shoot ratios were carried out on this stock. A preliminary report on changes in soil bulk density related to machine type and number of passes was completed.

Pre-harvest soil sampling and soil disturbance surveys were completed on the four summer-logged blocks and post-harvest measurement completed on two of these in the Golden alternative harvesting systems joint study. Pre- and post-harvesting disturbance surveys were summarized and soil chemical and physical analyses completed. Climate stations were established on two of the summer-logged blocks. Greenhouse studies were initiated to evaluate the effects of calcareous soils on seedling establishment and growth.

A problem analysis describing research needs and opportunities in forest soil erosion was completed. An ENFOR contract on the impact of biomass harvesting on soil disturbance and surface soil erosion was let. Advice and assistance was provided to the contractor including establishment of a climate station and design and construction of a rainfall simulator. A second ENFOR proposal was developed entitled "The Impact of Machine Travel on Soil Physical Properties" This is being merged with a basically similar study proposed by FERIC on trafficability of logging equipment. Through equipment purchases, first steps have been made to establish a soil physics/soil mechanics laboratory at PFC.

Water sampling, water and soil analyses and hydrometeorological data collection and processing was completed for the small lakes forest fertilization/water quality impact study near Victoria. Analysis of water samples for phytoplankton (University of Victoria) and zooplankton (Pacific Biological Station) was mostly completed. Two chapters were written for the final Spillimacheen and Green Mountain Fertilizer/Snow report for the BCFS.

Project members continued to be closely involved in activities aimed at reducing soil degradation from forestry operations including active participation on the TAC to the Interior Forest Harvesting Council, two Regional Harvesting Subcommittees and the Site Degradation and Rehabilitation Committee.

Projections

Fifth-year measurements at the Golden stumping and skidding soil-disturbance plantation will include plant-moisture stress, foliage sampling and nutrient analyses and top and root characteristics.

Soil disturbance surveys and sampling will be completed for the two remaining summer-logged blocks and two winter-logged blocks in the Golden District alternative harvesting study and a report prepared on changes in soil bulk density and soil chemistry for different site preparation treatments also in the same District.

Preliminary relationships will be developed among machine type, number of passes, bulk density and mortality of planted seedlings on the coastal ground-skidding site.

Cooperative work will continue on an ENFOR contract related to surface soil erosion and a poster presentation on this work will be prepared for the 7th Bioenergy R&D Seminar in Ottawa. A new ENFOR contract on machine/soil interactions will be initiated.

A new study will be initiated on computer digitization and digital image analysis of aerial photographs for the determination of the areal extent of soil disturbance on cutover areas.

The Canada/US regional meeting of the International Society for Terrain Vehicle Systems will be hosted by Project members.

G.W. Coombs

C.E. Dorworth

R.J. Whitehead

Forest weed control strategies

Project Leader: G.W. Coombs, R.J. Whitehead
Professionals: Dr. C.E. Dorworth, Dr. E.T. Oswald, Dr. R. Prasad, Dr. R.E. Wall, (Drs. T. and F. Sieber: S. F. Shamoun: FRDA Contract)
Technicans: B.N. Brown, R.K. King, T.A.D. Woods

Objectives

To investigate interactions between site ecosystem components and management entries at harvest, site preparation and planting, and determine their effects on secondary plant succession.

To identify and develop cost-effective biological, chemical and manual or motor-manual tools for weed control during plantation establishment.

To develop forest management strategies that achieve an optimum balance between silvicultural efficacy and impacts on non-timber resource values.

Achievements

Plots were established near Creston, to compare vegetation development following summer and winter logging in the ESSFc biogeoclimatic zone; summer logging was completed. Data collection continued on plots near Golden established to compare effectiveness of different scarification and burning treatments for site rehabilitation in the same zone. Micrologger-monitored climatic stations were established and maintained on both sites. Examination of propagation methods by false azalea and white-flowered rhododendron are underway.

Aerial photographs were taken of plots near Caycuse and Cobble Hill, established in 1988. Digitization of these photos was attempted; results showed that images from the 4-bit video camera were not useful due to poor resolution, however, images from the 8-bit video camera were better.

E.T. Oswald

R. Prasad

R.E. Wall

Fungus diseases of thimbleberry and aspen were collected in the Southern Interior and their causal agents tested for their potential use as mycoherbicides. Two fungi show potential, especially when combined with appropriate stress treatments. Local isolates of the fungus *Chondrostereum purpureum* were tested on red alder and big leaf maple on southern Vancouver Island. Mixed success from alder inoculations with *Melanconis* spp. and sub-lethal doses of glyphosate, revealed a potential for reducing amount of chemical herbicide required for successful weed control, but underlined the need for determination of optimum conditions for disease development. Successful isolation and characterization of endophytes and related pathogens of red alder was completed; comparisons of phytotoxicity are underway by greenhouse inoculation of plants and by generation of fungal protein profiles. Provenances of salal were grown in greenhouse containers for outplanting on two sites for field testing of potential fungal biocontrol agents.

A physiologist, Dr. Raj Prasad, joined the project late in 1988 via transfer from FPMI. He will commence studies in support of the biological control work to determine mode of action and to improve formulations for field application.

Final results from the Carnation Creek herbicide/environmental impact study were presented at a workshop in Nanaimo. The second posttreatment assessment of plots established in the Bush River drainage for comparison of chemical and motor-manual brushing treatment of shrub dominated spruce plantations, was completed. Results of Phase I (Cost, Productivity and Damage During Treatment) of a brushsaw cost-effectiveness study, on a similar site, were published as a FRDA Report. Data collection continued for Phase II (Silvicultural Efficacy).

Monitoring and supervision of FRDA contracts related to project objectives continued. Dr. Dorworth served on the FRDA Northern Interior Technical Advisory Committee. Dr. Oswald served as chairman of the Forestry Canada National Vegetation Management Working Group. Dr. Prasad served as Secretary on the International Weed Science Society. Mr. Whitehead was Silviculture Summarizer for Research Appraisal and Planning on the Expert Committee on Weeds (Western Canada Section). Study leaders actively participated in a wide range of extension and technology transfer activities, presenting talks or posters at a variety of symposia, technical committee meetings, and lectures at post-secondary schools and to the Silviculture Institute of B.C.

Mr. Coombs has assumed increased responsibilities in the Forest Development Program; his role in coordination of the Weed Control Strategies Project was transferred to Mr. Whitehead under the general supervision of J.T. Arnott (Project Leader: Seeds, Nurseries and Regeneration).

Projections

Studies will continue to collect, and analyze data, from established plots. Study sites near Creston will be burned and planted. Comparisons of 1+0 and 2+0 Engelmann spruce performance, in relation to vegetation succession, will be initiated. Interim reports will be generated for the Bush River and Redfish Creek studies of chemical or manual brushing on shrub dominated sites. Small scale field trials of promising fungi for control of thimbleberry and associated hardwoods in the Southern Interior will be initiated. Fletcher Challenge Co. will supply areas for field inoculations of red alder with *Melanconis* spp. Salal provenances, for future field tests of promising biocontrol agents, will be planted on sites prepared by MacMillan Bloedel. Further inoculations in the greenhouse with endophytic and related forms of fungi are planned. Comparisons and contrasts with various species and isolates of *Melanconis* spp. will be brought to a close and written in manuscript form. A new study of factors affecting efficacy and mode of action of promising mycoherbicides will be initiated.

Due to chronic problems in obtaining quality photography and applying digitized data to project objectives with the limited funding available, the Remote Sensing study will be terminated. Dr. Lee's effort will be concentrated, in future, on his study in Environmental Impact of Forestry Practices.

The Forest Weed Control Strategies project will be combined with Seeds, Nurseries and Regeneration under a new title, Forest Renewal.

J.F. Manville

T. Fraser

Specialized collaborative research and statistical services

Project Leader: Dr. J.F. Manville
Professionals: T. Fraser, Dr. J. Pannekoek, Dr. R.H. Silversides, Dr. C.S. Simmons
Technicians: R. Benton

Objectives

To provide specialized skills, in the areas of analytical organic chemistry, scientific computing, forest meteorology and applied statistics, by a series of contractual collaborative studies, by consultation and by provision of services, throughout all program areas within PFC.

J. Pannekoek

R.H. Silversides

C.S. Simmons

Achievements

Analytical organic chemistry: Fourier Transform Infrared was used to effect the non-destructive species identification experiments on wood specimens. Conifer foliage terpene samples were analysed for chemotaxonomic identifications and stress induced (acid rain) chemical changes. Isolated and identified structures of sesquiterpenoids from the whole wood of coastal alpine fir (*A. lasiocarpa*) to establish a chemical basis for separating this true fir from interior alpine fir (*A. bifolia*). Published two manuscripts.

Scientific computing: development of an insect spray trials database system is nearing completion; designed and supervised the conversion of PFC's Chemical Hazard Reporting and Inventory System (CHRIS) to the micro-computer based FOXBASE+ system; prepared guidelines for the selection and acquisition of scientific workstations, and prepared material for and submitted a new study on the automation of tree ring analysis via applied image processing.

Forest meteorology: continued and improved microclimate data collection for examining seedling microclimate differences at the site near Prince George; joint manuscript on the dispersal of mountain pine beetle accepted for publication; hosted 7th meeting of Advisory Committee on Forest Climatology and Meteorology; attended workshops and established project on climate change; reported on developments in automatic data collection systems determined from visits to Dycor, Campbell Sci., and J.D. Merrill; provided support to other PFC studies, e.g., monitoring infection episodes by white pine blister rust, leader temperatures affecting shoot weevils, monitoring climate for bark beetle, black-headed budworm, seedling regeneration etc.

Applied statistics: Provided advice and assistance, in the designing of experiments, the running of computer programs, the analyzing of research data, and/or the interpreting of results. Reviewed research proposals or draft papers originating outside the PFC. Instructed staff in the use of the proprietary statistical computer package SAS. Using SAS/AF and the SAS language, wrote and implemented the menu-driven statistical computer package MENUSAS, and gave courses in its use to PFC staff.

Projections

Work in the analytical organic chemistry study will be extended on chemotaxonomic studies of terpenes, wood extractives, pheromones. FTIR and NMR to include problems with pests, taxonomy, wood quality and with additional LRTAP funding, air pollutants effects on conifers. Scientific computing, will provide scientific computing support and in conjunction with computing services conduct an assessment of image processing/ graphics/ mapping systems and technologies to provide PFC with a unified cost-effective solution for applying this technology to research problems. Forest meteorology study will examine climate effects on seedling establishment, pests and tree growth, and long-term fire weather in B.C. and the Yukon will

be examined. The applied statistics study will continue to provide PFC research staff with support in the design of experiments, the use of statistical computer programs, the analysis of data, and the interpretation of results. MENUSAS will be further developed, to further help those researchers who are less computer-literate to access more easily the power of SAS. Courses in VMS Survival (simple computer usage with emphasis on dealing with numerical data), SAS Survival (simple statistical analyses by means of SAS), and SAS Basics (more complex SAS programming) will be given, as well as further instruction in the use of MENUSAS. Short courses on experimental design and statistical analysis will be developed.

6

G.A. Van Sickle

A. Funk

L. Humble

Forest insect and disease survey (FIDS)

Project Leader: Dr. G.A. Van Sickle
Professionals: Dr. A. Funk, Dr. L. Humble
Technicians: D.H. Clarke, R. Duncan, R.D. Erickson, R. Ferris, R.W. Garbutt, N. Humphreys, H.P. Koot, J. Loranger, D.P. Lowe, A. Stewart, R. Turnquist, L.S. Unger, J. Vallentgoed, C.S. Wood.

Objectives:

To provide part of an annual national overview of important forest insect and disease conditions, including acid rain, and their implications. To conduct quarantine-related surveys and activities. To support research by maintaining historical records, monitoring, reporting and providing requested collections and observations whenever possible. To provide liasion and technology transfer on behalf of Forestry Canada and FIDS to the forest community. To develop methods to improve forest insect and disease sampling techniques.

Achievements:

The annual monitoring and assessment of forest pest conditions in British Columbia and Yukon was conducted, and results were presented at national and regional forest prest reviews and were published. The most damaging insect in western Canada continued to be mountain pine beetle, with damage spread over 63 000 ha. Spruce beetle infestations declined to 1675 ha.

Defoliation of Douglas-fir by western budworm declined to 360 000 ha, while Douglas-fir tussock moth populations remained at low levels. Eastern spruce budworm defoliated 36 000 ha in the Ft. Nelson area and 2-year cycle budworms infested 102 185 ha in the Central Interior. Western blackheaded budworm and hemlock sawfly declined to 7 350 ha on the Queen Charlotte Islands, however, defoliations of western hemlock by the larchworm increased to over 4 830 ha near Holberg on northern Vancouver Island. Larch casebearer was generally endemic. An infestation of western hemlock looper in the Vancouver Forest Region collapsed. Major problems in mature and immature forests continued to be root rots, dwarf mistletoes, rusts and canker diseases. Black army cutworm killed and severely defoliated seedlings in slash-burned sites in the Cariboo, Nelson, Prince George and Prince Rupert regions. Cone and seed pests were widespread and destroyed up to 100% of the spruce cones in the northern part of the Prince Rupert region. Cummulative drought conditions during 1985-1987 contributed to the increased number of dead and dying conifer across British Columbia, particularly in drier parts of the south coast. Nearly 12 000 2-to 25-year old natural and planted conifers

in 129 stands across the province were surveyed for major pests and their impact. Gypsy moth occurred at seven sites. Forest tent caterpillar severly defoliated trees and shrubs over nearly 52 000 ha in parts of the Cariboo and Prince George regions and in the East Kootenay.

Projections

A general survey in support of a national overview of important pest conditions will be conducted and reported. A compilation of 35 years of records of parasites of common insects in B.C. is in preparation. A computer assisted mapping and analysis system is in use and is linked to other data bases such as the national forest inventory and national pest record retrieval system (INFOBASE). These tools will be used to analyze the extensive data base for pest cycles and correlations with forest ecological or climatic zones to improve forecast and spread models.

L. Safranyik

Bark and wood-boring insects

Project Leader: Dr. L. Safranyik
Professionals: Dr. F.G. Peet, Dr. T.S. Sahota,Dr. T.L. Shore
Technicians: R.E. Betts, A. Ibaraki, D.A. Linton

F.G. Peet

Objectives

To develop and promote management guidelines to reduce losses incurred by major bark and wood-boring insects.

T.S. Sahota

Achievements:

Twelve scientific and technical publications covering various aspects of bark beetle biology and management were prepared by project scientists.

T.L. Shore

Work concentrated on mountain pine beetle and spruce beetle in the following areas: hazard rating; effects of infestations on stand structure and dynamics; bark beetle dispersal and population quality; modelling of bark beetle population dynamics; and, information transfer. As part of the Canada/USA Agreement on mountain pine beetle, measurement of increment cores was complete for the 150 plots established in B.C. to evaluate mountain pine beetle hazard rating systems in lodgepole pine. An analysis of the 59 Cariboo plots was completed and the results presented at the Canada/USA Mountain Pine Beetle Symposium in July, 1989. To date, 25 of 30 lodgepole pine stands have been sampled in the Cariboo Region to evaluate the effects of mountain pine beetle infestation on the structure and development of residual stands. A data base has been established and data analysis is in progress.

A cooperative field study with Dr. B.S. Lindgren of PheroTech Inc., Vancouver, was carried out for the second year to assess the effects of verbenone on mountain pine beetle dispersal behaviour. Results were inconclusive but appear to indicate that verbenone does not significantly affect short range dispersal and attack behaviour. A paper was prepared for publication on the effects of wind on the local dispersal and attack behaviour of the mountain pine beetle.

Preliminary data analysis has been completed regarding the influence of the host tree on the quality of bark beetle populations. Samples from eight mountain pine beetle populations in different stages of infestation development have been obtained and prepared for analysis. Most of the practical work on a microanalysis of microelements involved in bark beetle cuticle hardening (in cooperation with Dr. A Fontaine, University of Victoria) has been completed.

In cooperation with Drs. Barclay and Simmons, a conceptual model of spruce beetle dynamics has been prepared for publication. This model allows an evaluation of the effects of climatic, stand and site factors and some managment practices on losses caused by the spruce beetle. A population dynamics model was built for the mountain pine beetle based mainly on published information regarding beetle biology and behaviour. This model, currently being tested, is a component of a more general model used for an evaluation of mountain pine beetle management operations.

Project scientists and technical staff provided written and oral advice and services to the forest industry, B.C. Ministry of Forests, educational institutions and the general public regarding bark beetle biology and management. Advice and services ranged from assessment of bark beetle hazard in the Carmanah Valley and methods for hazard rating stands for mountain pine beetle to discrimination of apple cultivars for Agriculture Canada based on digital imaging techniques. Project scientists also participated in 26 technical reviews, prepared one extension report, gave five lectures and seminars, and organized and/or presented papers at five meetings. Dr. Safranyik served on the thesis committees of three graduate students and as an adjunct professor, forest entomology at U.B.C.

Projections

Completion of analysis of mountain pine beetle hazard rating system for all plots on which final assessments of damage have been made; expansion of study of mountain pine beetle impact on stand structure and development to the Kamloops Region; continuation of cooperative work with Dr. Lindgren re effect of verbenone on mountain pine beetle dispersal; continuation of cell image analysis work re bark beetle population quality and its relation to stages of outbreak development; completion of development of the mountain pine beetle population dynamics model; and, establishment of spacing trials in mature lodgepole pine in the Cariboo Region for reducing losses from mountain pine beetle.

M.A. Hulme

J.W.E. Harris

H.A. Moeck

I.S. Otvos

R.F. Shepherd

H.S. Whitney

Biological control of forest pests

Project Leader: Dr. M.A. Hulme
Professionals: Dr. J.W.E. Harris, Dr. H.A. Moeck, Dr. I.S. Otvos, Dr. R.F. Shepherd, Dr. H.S. Whitney
Technicians: A. Dawson, T.G. Gray, M. Talmon de l'Armee
Visiting trainee: Tan Yingchun

Objectives

To evaluate the use of natural enemies as control agents for forest pests and, where appropriate, incorporate natural enemy manipulations into forest pest management strategies.

Achievements

A geographic information system was used to compare the spacial patterns of outbreak of Douglas-fir tussock moth with those of forest ecological zones, temperature and moisture regimes. Temperature played the domiant role. The temporal patterns of all recorded Douglas-fir tussock moth outbreaks in North America were compared. In northern populations, outbreaks were cyclic in response to widespread coordinated virus epizootics. Outbreaks in southern forests were more long-lived and not cyclic because of the isolation of infested stands.

Spring, summer and fall sampling of larch casebearer showed continuing low populations with about 30% overwintering mortality. Of the four species of parasitoids introduced in attempts to regulate the pest population, two species, *Agathis pumila* and *Chrysocharis laricinellae* became established, the latter becoming the more common parasitoid reared from collected larch casebearer. Winter moth populations and resultant damage to oak and fruit trees remained low following introduction of *Cyzenis albicans* and *Agrypon flaveolatum*.

Trials designed to control spruce weevil damage were undertaken in 1988 at six locations in British Columbia with a further two locations being added in 1989. The method comprises clipping infested leaders prior to emergence of the adult weevil and returning the caged leaders to the plantation. The cage screening confines the adult weevil but allows egress of natural enemies that developed in the infested leaders.

Testing was continued on the feasibility of releasing clerid beetles to reduce populations of mountain pine beetle. An exotic clerid species from Europe was imported and successfully reared in the laboratory. However, a

planned inoculative release against mountain pine beetle had to be cancelled when mating was shown to occur between exotic and native clerids. In another line of research *Beauveria bassiana* is being tested for its ability to reduce populations of mountain pine beetle. To ascertain the fate of applied *Beauveria bassiana*, suitable detection methods are needed to identify the isolate released. Electrophoresis, immunochemistry and recombinant-DNA technology have been applied to several *Beauveria* isolates from North America and China that are known pathogens of various forest insect pests.

Projections

Current populations of two defoliators are at opportune levels for testing the bacterium *Bacillus thuringiensis* as an effective biological insecticide. Plans are to use an ultra-low-volume application (1.2L per ha) on the western spruce budworm and on the blackheaded budworm. At present no insecticide product is registered for control of the latter pest. Testing will continue to regulate spruce weevil populations using leader clipping and enhancement of natural enemy populations. Testing will be conducted to find a warning system for impending outbreaks of black army cutworm. Experiments are planned to determine if fertile hybrid adults are produced following the mating of native and exotic clerid beetles.

W. J. Bloomberg

G.D. Jensen

D. Morrison

Protection of second growth stands from root and stem diseases

Project Leader: Dr. W. J. Bloomberg
Professionals: Dr. G.D. Jensen, Dr. D. Morrison
Technicians: D. Chu, A. Hall, A.L.S. Johnson, G. Reynolds

Objectives

To define the epidemiology and impact of root and stem diseases in second-growth stands; to develop control strategies; to expedite application of research results, and to act as resource personnel and/or project leaders on Forest Resource Development Agreement (FRDA) projects related to root and stem diseases.

Achievements

A comprehensive analysis was completed of 30-year records of root disease in three plantations on eastern Vancouver Island. The plantations have been examined at approximately five-year intervals starting in 1958 when they

were 15 years old. All trees (approximately 17,000) have been stem-mapped and their growth and disease condition recorded at each examination. The data has been stored in the computer and a program has been written to facilitate retrieval and analysis of the records. The analysis showed how the diseases develops over time and space in relation to various plantation conditions. The most important factors were level and uniformity of stocking, and species, origin, size and condition of trees. The findings provide a basis for minimizing root rot in young plantations.

Cooperation continued between Pacific Forestry Centre and the B.C. Ministry of Forests in integrating root rot modeling with Douglas-fir stand growth modeling. The model which has been converted to PC format is intended for technology transfer of disease impacts and control.

The Phellinus root rot management cooperative met twice at Pacific Forestry Centre to exchange information and determine priorities for its goals. The co-op was formed to make the best use of available expertise and resources of universities, government research agencies and the forest industry. The cooperative will serve as a clearing-house for information, a vehicle for collaborative disease research and management, a vehicle for possible funding and a spokesgroup for root diseases.

Examination of 1980-81 root inoculations showed that, contrary to expectations, none of the trees had viable *P. weirii* in their root systems, although a number of the inoculations produced an initial response in both bark and wood. Light and scanning electron microscopy studies showed the tree subsequently reverted to normal growth patterns at the site of interaction. An inoculation technique for introducing *P. weirii* under conditions simulating normal root contact was designed and preliminary testing was successfully carried out.

A study was continued on Vancouver Island to investigate the effects of juvenile spacing on a Douglas-fir plantation infected with *Phellinus weirii*. The study will compare the spread of the disease in unspaced, uniformly spaced and strategically spaced blocks. Comparisons of volume production will also be made among the treatments.

Five *Abies amabilis* stumps colonized by *H. annosum* were excavated and the volume of the stump and roots and the volume of wood colonized were determined. Stumps 5 to 20 cm in diameter with a range of surface area colonized are analyzed to relate surface area colonized to colonization of roots and spread to residual trees.

Five Sitka spruce stumps on the Queen Charlotte Islands that were colonized by *H. annosum* were excavated and analyzed as above. The stumps were well colonized, and four residual trees had become infected through root contact with a stump; however, development of the fungus in the trees was less than expected considering the stand was spaced 9 years ago. In collaboration

with D.B. Redfern, British Forestry Commission, 50 stumps from each of 5 stands spaced within the past 2 years were analyzed for infection by *H. annosum* and for moisture content; the data is being analyzed.

Armillaria diploid isolates and monosporous testers or isolates of Inonotus tomentosus were sent to four researchers in the USA and Canada. Sixty-four cultures of root disease and wood decay fungi were identified for BCMF, FRDA contractors, FIDS and the public.

The 1988 meetings and field trips of IUFRO Working Party on Root and Butt Rots were organised and run. The meeting was attended by 92 delegates from 17 countries. Eleven symposia were organised. The proceedings of the Seventh International Conference on Root and Butt Rots (IUFRO Working party S2.06.01) were prepared and published.

11 root rot surveys totalling 440 ha were analyzed for BCMF and forest companies.

Field examinations were undertaken on request of BCMF and forest industry foresters.

Seminars and field trips were arranged for identification and control prescriptions.

Involvement with related FRDA projects continued.

Projections

To supply forest managers with guidelines for recognition, risk assessment, impact estimation and control strategies for the major root and stem diseases.

G.E. Miller

A. Ekramoddoullah

R.S. Hunt

M. Meagher

R.N. Sturrock

E.E. White

Regeneration pests

Project Leader: Dr. G.E. Miller
Professionals: Dr. A. Ekramoddoullah, Dr. R.S. Hunt, Dr. M. Meagher, R. Sturrock, Dr. E.E. White
Technicians: D. Craigdallie, J. Dennis, B. Foord, A. Ibaraki, G.R. Lait, D.S. Ruth

Objectives

Reforestation efforts in B.C. have increased significantly in recent years. This increase in activity stems from the Canada/British Columbia Forest Resource Development Agreement, which has as its primary objective the reforestation of unsatisfactorily restocked forest land, in addition to increased planting by the B.C. Forest Service. The resulting increased emphasis on production of seeds and seedlings, and establishment of new plantations has demonstrated the need for pest management programs in seed orchards, nurseries and young plantations. Two client surveys conducted in 1987/88 indicated that regeneration pests were amongst the highest research priorities in B.C. from the perspective of operational foresters. Development and improvement of the pest management systems requires research in both basic and applied aspects of regeneration pests. Development of western white pines which are resistant to white pine blister rust would afford a silvicultural solution for sites where *Phellinus* root rot is a problem because of white pine's resistance or tolerance to this disease.

With this as background, the objectives of the project are: i) to identify the major insect and disease pests of forest nurseries, seed orchards and reforested areas; ii) to develop pest management strategies to keep the incidence of these pests below economic thresholds; iii) to develop techniques that allow early detection and meaningful predictions regarding the pests; iv) to evaluate the genetic interactions between western white pine and white pine blister rust through biotechnology; and v) to assist in transfering new technology resulting from this research into operational use.

Achievements

Some of the year's important accomplishments included the following:

Nursery diseases: i) Preliminary studies on the possible causes of a root rot in container-grown seedlings, including organism identification, its ecology and the tree species affected, were initiated (Sutherland). ii) In collaboration with AFS Research, "ventilated" styroblocks and movement of forced air through the seedling canopy are being evaluated for grey mould management

(Sutherland). iii) The publication "Diseases and Insects in British Columbia Forest Nurseries" is undergoing revision (Sutherland).

Cone and seed insects: iv) The third IUFRO Cone and Seed Insect Working Party Conference was held in Victoria in June (Miller). v) A summary of over 30 years survey data for cone and seed insects was presented to the IUFRO Cone and Seed Insects Working Party Conference (Miller). The paper will be included in the conference proceedings. vi) A study of cone slicing as a method of indexing seed crops was completed (Miller). A manuscript is in preparation. vii) The study focused on the physiology of prolonged diapause in cone and seed insects was terminated (Sahota). viii) A damage prediction system for spruce cone maggot and spruce seed moth, based on egg counts, is being developed (first approximation from data for two years) (Sweeney). ix) Poor insect response was observed in tests of attractiveness of coloured sticky traps to spruce cone maggot (Sweeney).

Plantation Diseases: x) The causal organism of a new leaf disease of aspen in northern B.C. has been described as a new species of *Pollaccia* and its teleomorph has been produced in culture (Funk).

White pine blister rust: xi) Assisted in the organization of a symposium on white pine management (Hunt). xii) Selected 400 potential parent white pine trees, in cooperation with B.C. Forest Service and private companies, for evaluation of resistance to blister rust and inoculated seedlings from about 120 parent trees with blister rust for evaluation of resistance (Hunt and Meagher). xiii) In cooperation with industry and the B.C. Forest Service established nine plantations for evaluating and demonstrating the resistance/tolerance of white pine to root rots, and six plantations to evaluate the resistance of American white pine seed sources to blister rust (Hunt and Meagher). xiv) Variability in chloroplast DNA of western white pine provenances was examined (White). Coastal and interior pollen appeared to differ. xv) In collaboration with the University of Victoria, cDNA libraries were produced to determine whether challenging white pine with western gall rust induces changes in gene expression (White). xvi) A study using immunology and protein chemistry in evaluating blister rust resistance in white pine was established.

During 1988/89 project scientists published 6 papers and 2 abstracts in scientific journals, 7 papers and 2 abstracts in conference proceedings and 1 FRDA publication. Project personnel presented lectures/workshops to forest community, scientific and university audiences. More than two hundred and fifty letters/reports were prepared for enquiries from forest nurseries and seed orchards.

Changes to project staff in 1988/89 included Dr. Abul Ekramoddoullah, a protein chemist/immunologist, joining the white pine team to assist in the development of blister rust resistant trees; and the reassignments of Ms. Rona

Sturrock (forestry officer) and Mr. Tad Woods (technician) to other projects. Dr. Sutherland increased his activities on nursery diseases from about 20% to 50% of his time.

Projections

Diagnosis and pest management recommendations will continue for diseases and insects in seed orchards, nurseries and young plantations. A new study on root rots affecting seedlings in container nurseries will be established. The revised manual of nursery pests (CFS/BCFS Joint Report No. 12) will be published. With the departure of Dr. Sweeney (Post-Doctoral Fellow) and the anticipated retirement of Douglas Ruth (technician), research on cone and seed insects will be suspended. Manuscripts based on previously collected data will be prepared. The study focused on plantation diseases will be terminated under this project, but will continue under the Forest Insect and Disease Survey. Survival and expression of resistance in field planted white pine will continue. Rust-inoculated and uninfected white pine seedlings will be screened for gene expression and associated differences in protein profiles. A survey of DNA variation in white pine blister rust will be completed and reported. FRDA related activities, such as monitoring research contracts, will also continue.

J.R. Sutherland

Pinewood nematode

Project Leader: Dr. J.R. Sutherland
Professionals: Yang, Baojun (Visiting scientist-China), Dr. T.S. Panesar (post-doctoral fellow, Natural Sciences and Engineering Research Council)

Objectives:

To research the biology, pathology and hosts of the pinewood nematode (PWN) on Canadian tree species, and to answer questions that Canadian, European and other officials raise on these matters. To study PWN survival in forest products. To serve as scientific authority for Forestry Canada-funded contract research on PWN.

Achievements:

Data from the host range studies with 24 species of Canadian conifers and **m** and **r** form nematodes were compiled, analyzed and a draft manuscript prepared. Pathogenicity studies using an **m** form PWN isolate from Norway and Scots pine seedlings were completed. Early in 1989 the pathogenicity of

this nematode to Canadian conifers will be determined. Late in 1988, seedlings were received from the U.K. for inoculation (summer, 1989) with Canadian PWNs. Studies were completed to determine if PWN-infested wood chips could serve as inoculem for the nematode to move from chips to seedling roots and cause pine wilt. These results are being analyzed. Studies continued on the effects of temperature and relative humidity on PWN survival in wood chips and digital analysis techniques were developed to quantify the effect of these environmental parameters on PWN survival. Dr. Sutherland continued serving as scientific authority for PWN contract research at Simon Fraser University. During the year a U.K. delegation visited here regarding cooperative research. A manuscript by Dr. K. Futai (visiting scientist 1987-88) was prepared and submitted for publication and another draft manuscript on digital analysis for studying PWN survival was prepared.

Projections

In a cooperative study with Simon Fraser University researchers, a nematode progeny (m x r form nematodes): pathogenicity study will be made using Scots pine seedlings. Pathogenicity studies will also be done using U.K. seedlings and Canadian PWNs. Manuscripts will be prepared on completed work and liaison will be maintained with contract and other researchers in Canada and abroad.

W. Stokes

J. Burch

K. Finck

D. Mills

A. Robinson

Program implementation

Project Leader: W. Stokes
Professionals: J. Burch, K. Finck, D. Mills, A. Robinson
Support Staff: B.Reid, A. Harvey, G. Zimmerman

Objectives

To represent Forestry Canada's responsibilities and interests in the implementation of forest development initiatives, which currently focus on programs under the five year, $300 million, Canada-British Columbia Forest Resource Development Agreement (FRDA). To provide program marketing and coordination, proposal development, and administrative, monitoring, extension and liaison services required in the implementation of FRDA and other forestry development programs.

Achievements

The FRDA Program has completed its fourth year treating approximately 415,059 hectares, surveying 686,000 hectares, with expenditures to date of $173.4 million. The activities were directed to backlog reforestation, intensive forest management, research, evaluation and implementation activities and included the federally managed Private Forest Lands, Federal Forest Lands, Municipal Forest Lands and Indian Forest Lands Programs. The comprehensive FRDA statistical data base (DEVMIS) was refined and made more responsive for regional program management. Activities included acting as the secretariat to the FRDA Management Committee, providing liaison with internal and external auditors, and the preparation of briefing notes, correspondence and annual reports.

Liaison continued between the Forestry Canada, the FRDA Forest Advisory Committee and other agencies, universities and industry to achieve cooperative effort on a number of forestry development projects.

Projection

To continue to provide information, implementation and monitoring services for FRDA and other Forestry Canada development programs; provide liaison with the Province, industry, universities and other agencies to ensure maximum utilization of FRDA opportunities and to promote the interests of Forestry Canada; research Forestry Canada's participation in other federal programs and to participate in dialog on possible future forest development initiatives.

Dean Mills

FRDA Cost Shared Operations Programs

Program Implementation - Dean Mills, R.P.F.

Objectives

To represent Forestry Canada as co chairman of the Backlog Reforestation and Intensive Forest Management Working Group for the Management Committee of FRDA, assist the FRDA Coordinating Committee; to undertake project and program monitoring ensuring that the FRDA guidelines and the objectives of Forestry Canada are followed; To provide liaison with other government departments and industry; To prepare briefing notes, the annual report and other responsibilities pertaining to the operational programs and activities of FRDA; participate in dialog on possible future forest development initiatives; and assist in the implementation of other cooperative forestry agreements.

Achievements

The operations components of FRDA completed its fourth year treating approximately 415,059 hectares creating 637,800 person days of employment for an expenditure of $161.1 million.

The Silviculture Joint Adjustment Committee released a special report on Human Resource Issues in the B.C. Silviculture Industry. Other activities included providing liaison with other government agencies including the Ministry of Environment, and the preparation of program/ project authorizations, briefing notes, correspondence and the FRDA annual report.

Projection

To continue to provide information, implementation and monitoring services for FRDA and other Forestry Canada development programs; provide liaison with the Province, industry, and other agencies to ensure maximum utilization of FRDA opportunities to participate in dialog on possible future forest development initiatives which will help ensure the continued existance of an abundant, high quality forest resource base.

G.W. Coombs

D.K. Haley

Extension, Demonstration, Research and Development Program (FRDA)

Project Leader: G.W. Coombs, R.P.F.
Professionals: D.K. Haley, R.P.F.

Objectives

To ensure that all extension and demonstration, and research proposals received under the Federal Direct Delivery component (FDD) of FRDA meet the goals, objectives and priorities as set down in the FRDA-FDD 5-Year Research Plan. To administer, monitor and evaluate all FDD approved research projects to ensure that a satisfactory result is achieved by each approved project. To ensure the extension and demonstration to field foresters of the results of all research projects, as well as key current forestry practices, funded under the FRDA-FDD.

Achievements

Since the beginning of FRDA, the FDD-Technical Advisory Committee has received a total of 232 unsolicited E,D,R&D proposals for consideration for FDD funding. Of this total, 22 proposals were received and reviewed in 88/89, and of these 12 were approved to commence. The total number of projects which have been approved and supported under the Federal Research Component of FRDA is 66. Of this total, 25 projects had been completed to the end of the 88/89 fiscal year. A total of 13 FRDA reports have been produced from the research funded under the Federal Research program. All of these reports were produced in the 88/89 fiscal year. In addition, there have been 16 Research Memos produced in this fiscal year for completed research projects. These memos give an executive summary of the results of these projects. A Research Memo (#067) which summarizes the objectives and progress to date for all the 66 Federal Research Projects was prepared and distributed in January 1989 to the forestry community. Several of the on-going Federal Research Projects have been reported in the FRDA "Solutions" and "Renewal" newsletters which are sent out to the forestry community. Special signs for use at specific Demonstration sites of some of the research projects were developed. These signs which give the title, objectives and have a map showing the study layout of the specific studies were set up to enable self guided tours to be carried out on each the specific demonstration sites. A total of 6 of these signs have be installed in the field. Pamphlets were developed and printed for use as self-guided tour instructions for 3 of the FRDA Federal Research Demonstration sites. Two seminars were given at PFC by Federal

Research proponents on the specific research projects which they are carrying out under FRDA. In addition, several presentations were made at various forestry workshops and meeting across B.C. on the results to-date of specific projects. Work began on developing a format for posters for most of the research projects. These posters will be displayed at PFC and at various forestry workshops and seminars as a means of communicating the results of the various projects to the field foresters and others.

Projections

Considering that 1989/90 is the last year of FRDA, a major effort will be placed in this last year in the extension and demonstration of the research results of the on-going projects. Thus priority for funding will, therefore, be given to ensure the completion of these on-going projects and the extension information of these projects to ensure that the clients are exposed to the benefits of the results of this research. A series of one day seminars will be held across B.C. to present the results of this research which was carried out under the FDD Research Program to the field foresters and managers. Research which will be presented in each area will be applicable to that specific area. Consideration will will also be given to presenting the applied results of some of the PFC's A-Base Research and Cost-shared research where it will fit in. Posters will be prepared for most of the FDD research projects. It is anticipated that approximately 25 posters will be prepared. These posters will be displayed at PFC, at forestry workshops, and at the one day seminars which will presented as part of the FDD Research Extension and Demonstration Program. It is anticipated that approximately 30 FDD FRDA research reports with Research Memos will be prepared and distributed to the forestry community and others. Special Demonstration Signs will be prepared and installed at 10 of the Demonstration Sites funded under the FDD program. In addition, self-guided tour pamphlets will be prepared for 5 of these sites. All of the field sites of the FDD Research which do not presently have a general FRDA Research sign will have a sign placed at the research site. The PFC seminar system will be used to present 4 more of the federal FRDA research projects. As well, presentations of specific projects will be given at various Silviculture Committee Workshops.

John Burch

FRDA Private Forest Lands Program

Program Coordinator: John Burch, R.P.F.
Professionals: K. Finck, R.P.F.

K. Finck

Objectives

To provide an opportunity for private land owners to bring their potentially productive forest land under intensive management, thereby contributing to the social and economic benefits available to B.C. through the Forestry Canada managed component of FRDA.

Achievements

During the first four years of this $7 million dollar program, FRDA has contributed $3.2 million to assist landowners with 235 projects. Before any reforestation or intensive forest management activities can be undertaken a forest inventory and management plan, or in some cases silvicultural prescriptions only, must be prepared. To date over 50,000 hectares of forest land has been surveyed, and silvicultural work has been carried out on about 10,000 hectares.

A handbook - Managing Your Woodland - was published in cooperation with the B.C. Ministry of Forests' Woodlot License Program, and has been distributed to all of the landowners involved in the Private Forest Lands Program plus 1,000 other interested forest landowners.

A Municipal Forest Lands Program was launched to encourage sound forest management and an increased awareness of forestry potential on watersheds and other municipal forest lands.

Projection

The demand for assistance continues to increase as more landowners become aware of the program. Also many of those who previously implemented projects on their lands have requested further funding to initiate additional silvicultural projects.

The development of an extension service program is planned that will provide landowners with assistance and information regarding silvicultural practices, small scale forestry equipment, and transfer of other appropriate technology. An increase in extension services will be provided to municipalities under the Municipal Forest Lands Program.

The Forest Management Handbook is now being reprinted, and will be widely distributed to interested private forest landowners.

A. Robinson

FRDA Federal Forest Lands Program

Program Coordinator - Arthur Robinson, R.P.F.

Objectives

To provide technical forestry assistance and support to other federal agencies in developing integrated management plans on federal forest lands and to encourage the implementation of reforestation and intensive management practices on their potentially productive forest lands.

Achievements

Management plans for lands controlled by the Department of National Defense (DND) are being implemented. Integrated harvesting and silviculture contracts were completed at DND's Nanoose Bay and Rocky Point properties. These projects included planting over 60,000 seedlings, commercial thinnings, and other silviculture activities. A cooperative work plan was implemented with the Attorney General's office to create rehabilitation employment and training through the forestry activities at Nanoose Bay. Inventories and management plans were completed for the Department of Transport's (DOT) Prince George Airport and the Ferndale Institute (Correctional Services Canada). Liaison with the Department of Fisheries and Oceans and DOT was initiated to encourage the optimization of their forest resources. Two videos on DND's forest management program were produced. Liaison and extension services with other agencies, institutions, industry, the Attorney General's office and the Ministry of Forests were expanded.

Projections

Integrated forestry activities will be expanded. New DND projects, at the Masset property on the Queen Charlotte Islands, Comox, Saanich and Aldergrove will be initiated. Inventory and management plans will be completed for three Department of Transport properties and for a Department of Fisheries and Oceans property. Integrated projects such as these will serve as models for small scale forestry and multiple resource use on other properties.

Mark Atherton

W. Coombs

R. Sturrock

FRDA Indian Forest Lands Program

Program Coordinator: Mark Atherton, R.P.F.
Professionals: W. Coombs, R. Sturrock

Objectives

To promote and manage the Indian Forest Lands Program - a Forestry Canada component of FRDA; to determine the forest potential and increase the forest productivity of Indian reserve lands; and to contribute to the social and economic benefit of Indian people.

Achievements

During the first four years of the program, FRDA has contributed $4.1 million to assist 97 Indian Bands with treating 4270 hectares and surveying 208,000 hectares.

Staff implementing the Indian Forest Lands Program increased from one full time to two full time and one part time with the addition of Rona Sturrock and Wayne Coombs to the program.

Two issues of the newsletter "Tree Talk" were produced and distributed to all Indian bands and tribal councils in the province. In addition, a handbook, "Managing Your Woodland: A Non-Forester's Guide to Small-Scale Forestry in British Columbia" was published in cooperation with the British Columbia Ministry of Forests and the Private Forest Lands Program. The handbook was distributed to all bands and tribal councils participating in the program and was made available to other interested parties upon request.

Financial assistance was provided to the establishment of the Intertribal Forestry Association of British Columbia, a native organization created to encourage and advise Indian bands as to the potential and techniques of improved forest managemnt.

Projections

The program continues to increase as bands develop their management plans and seeking funding to implement the silvicultural activities. The budget for the 1989/90 fiscal year is $1.9 million from which approximately 50 new and ongoing projects will be developed on reserve lands throughout B.C.

W. Matosevic

Prince George District Office

Forestry Officer - Walter Matosevic, R.P.F.
Support Staff: Marion Suel

Objectives

To provide access to Forestry Canada programs and support Forestry Canada objectives in the interior and northern areas of B.C. This includes the dissemination of information on the details of Forestry Canada programs and their results. To provide assistance to the Private, Indian and Federal Forest Lands FRDA programs. To participate in project development with industry, industry organizations, Ministry of Forests and other agencies.

Achievements

The Prince George office has assisted in the development, implementation and monitoring of 85 private land projects, 20 Indian land projects, one federal lands project and five extension demonstration projects. The office has set up a Forestry lecture series with the College of New Caledonia in Prince George, the Northern Silviculture committee and Selkirk College in Castlegar, and is currently planning a major Mixedwood Symposium to be held in Fort St. John in September, 1989. It has also been active as a base of operations for Forestry Canada research projects, and a point of contact for the local forestry community and the public sector through which they can communicate their particular needs and concerns.

Projections

The importance of the Prince George office will continue to increase as a convenient Forestry Canada contact for industry, the public and other agencies, and to support Forestry Canada objectives in central and northern British Columbia.

J.P.G. de Lestard

A. Shortreid

Forestry relations and technology transfer

Project Leader: J. P. G. de Lestard, R.P.F.
Professional: A. Shortreid, R.P.F.

Objectives

To establish and maintain contact with the forestry community and the public sector in an advisory and consultative capacity, and to promote and strengthen Forestry Canada research and development initiatives and programs in the Pacific and Yukon Region. To provide selected technology transfer services to PFC staff and clients. To provide professional support during the development and implementation of forestry agreements.

Achievements

Promoted forestry awareness and Forestry Canada's public image by: serving as Section Chairman of the Federal Government Division of the United Way Campaign of Greater Victoria; organizing technical workshops, including a FERIC/PFC workshop for Executives; serving as Program Chairman of the C.I.F. Vancouver Island Section; attending annual meetings of industrial associations (COFI - NILS, CLMA); attending meetings of the COFI Debris Control Board; the G.V.R.D.'s Seymour Demonstration Forest Advisory Committee and the S.I.B.C.'s Board of Directors; serving as course evaluation facilitator for S.I.B.C.; preparing key ministerial briefing notes; planning the IUFRO 1990, Post Congress Excursion - "The Far North - Yukon/Alaska" and attending three organizational meetings in conjunction with the tour; speaking to forestry and public groups, including the Juan de Fuca Chamber of Commerce; serving on the PFC Seminar Committee and arranging for and introducing speakers for the seminars; establishing and participating in displays at special functions including the Prince George Regional Forestry Exhibition, Home Improvement Show in Esquimalt and University of Victoria Career Day; initiating contribution agreements and serving as scientific authority and departmental representative for FRDA projects; organizing and attending a "How to Make Powerful Presentations" Seminar for industrial, provincial and federal employees; participating in the allocation of funding for projects under the Economic Development Agreement, Renewable Resources Sub-agreement in Whitehorse, Yukon; attending the Canadian Pulp and Paper Association's Forest Management Group meeting and field trip in Kamloops; serving as a Director of the Junior Forest Wardens Association of Canada; serving as a member of the Malaspina Forest Resource Technology Advisory Committee and assessing courses for the college; developing a FRDA promotional speech, slide show, video and novelties for distribution; organizing and conducting tours and workshops for Argentinian, ASEAN, and Chinese delegations, professional and school groups and numerous clients; maintaining active participation on the Steering Committee of the GIS '89 Symposium

(Vancouver) and the Northern Mixedwood '89 Symposium (Fort St. John); attending CIF, CSC, SISCO and FERIC meetings and workshops; and participating in National Forestry Week activities.

A technology transfer survey of PFC project and study leaders was completed outlining areas of need and identifying efficiencies which could be implemented. A survey of selected clients was continued on an informal basis. Development of a comprehensive technology transfer plan, including strategic goals for PFC, has commenced to provide future direction to the technology transfer program. Initial disclosures were submitted to Canada Patents and Development Ltd. covering Dr. D.G.W. Edward's work on the IDS Live Seed Density Separator, Dr. J. Pannekoek's Chemical Hazard Reporting and Inventory System (CHRIS), Dr. C. Dorworth's work on bio-control of alder and salal and Dr. J. Pannekoek's work on developing an Automated Ring Counting and Analysis System (ARCS). Developmental and licensing activities are continuing. Software development and support services were provided to the Registration Sub-committee of the 1988 CIF HAMPCO prior to and during the annual meeting at Prince Albert, Saskatchewan. Input and comments were supplied to strengthen PFC technology transfer and FRDA Extension, Demonstration and R & D activities. Coordinated the development of a "Guide to Peak Flow Estimation for Forest Road Stream Crossings" for Fletcher Challenge Canada Ltd. This project involved cooperation among Forestry Canada, the Ministry of Forests, the Ministry of Environment (Water Management Branch) and Fletcher Challenge Canada Ltd. Assisted the Economics Group to develop, test and refine the Multiple-Use Sustained Yield Calculator (MUSYC) timber harvest scheduling optimization model. The large number of T.F.L. applications and roll-overs in B.C. has created a demand for the Vax-based and the PC-based versions of this product by consultants and large integrated companies.

Projections

Liaison and technology transfer activites will continue to be expanded throughout the forestry community and public sector in the Pacific and Yukon Region. Ongoing communications and visitations are expected to encourage clients and potential clients to capitalize on Forestry Canada regional and national research and development programs and accomplishments. Emphasis will be placed on promoting increased awareness of the economic, social and environmental benefits being derived from the Canada-British Columbia Forest Resource Development Agreement. When completed, a report on the technology transfer survey of PFC project and study leaders will show technology transfer activities planned for the next three years. Included will be suggestions for assisting scientists to develop practical research applications for transfer to clients. Emphasis will be placed on the development and submission of applications for patents and licenses to Canada Patents and Development Ltd.. Activities will include participation on the Steering Committees and providing coordination for the Northern Mixedwood '89 and GIS '90 Symposia and the development of a national technology tranfer 'working group'. Technology transfer advisory and operational services will be expanded in response to client requirements and technological developments.

G.H. Manning

G.M. Townsend

W.A. White

Development of economic guidelines

Project Leader: Dr. G.H. Manning
Professionals: Dr. G.M. Townsend, Dr. W.A. White
Technician: C. Macklin

Objectives

To provide economic and policy advice to the Department, its cooperators and the management and staff of PFC, to improve the information base in forest economics, and manage PFC's participation in the ENFOR (Energy from the Forest), program.

Achievements

The major thrust of the project continued to be in support of the Canada-B.C. Forest Resource Development Agreement. Economic studies under way included further investigation of forest dependent communities, cost of logging second-growth coastal timber, impact of future manufacturing technologies on silvicultural prescriptions, analysis of residual chip supply, integration of logging and silvicultural planning, analysis of the shake and shingle industry and a number of studies related to forest management decision models.

With regards to ENFOR, in 1988/89, one contract was in progress: an economic evaluation of future potential for utilization of biomass for energy in B.C.

Projections

The project will continue to provide planning, economic and policy advice and liaision as required by ForCan/PFC staff and other client agencies. Specifically, FRDA-related studies will continue, as will studies related to marketing and utilization opportunities for B.C. forest industries. Forest management decision modeling will also continue, as will management of the Centre's ENFOR program.

R.M. Dean

W.D. Evans

E.K. Hopps

H. Gray

Administration

Management Services Officer: R.M. Dean
Finance Officer: W.D. Evans
Physical Plant: E.K. Hopps
Photographer: E. Chatelle
Material Management: H. Gray
Administrative Support: J. Andersen, D. Barwise, P. Chambers(*retired*),P. Deering, S. Flarrow, B. Gee, D. Greenway, R. Hagel, H. Hendriksen(*retired*), J. Horsland, E. Hosie, A. Inness, M. Johnson, G. Kazmiruk, J. Lum, H. Matson, R. McPhee, M. Mosley, W. Pearce, S. Reid, R. Richardson, J. Strobbe, B. Vander Heiden
Casuals: D. Brady, C. Park, G. Roke, S. Van Ek

Objectives

To provide general administrative support services including material management, financial services, records management, word processing, secretarial services, fleet management,mail and reception-switchboard services; to provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide physical facilities support for the Centre and 12 field stations.

Achievements

The financial unit maintained effective reporting systems and provided monthly and bi-monthly reports to managers. New financial reporting systems were examined by both Forestry Canada HQ and the region with the Teradata system being made available to provide additional financial information. The MMIS system was introduced in the Material Management unit and training completed late in the fiscal year. Eight new vehicles were purchased and eight were disposed through Crown Assets. All building services were maintained in support of research programs although problems were encountered with the freezing of some water pipes in early March. Two new walk-in growth chambers were purchased and installed along with a new security system. Environment Canada conducted a PCB storage review at the Centre which resulted in a recommendation to change our ballast storage area. Several employees (as noted) retired during this review period.

Projections

Administrative and support services will continue to be provided to the research and development programs on a timely basis. A consulting contract has been issued to review the effectiveness of support services with recommendations to be presented to management in June 1989. Major renovations to the electrical system at New Denver will be completed this summer as well as minor renovations to Smithers and Wasa.

Minor construction at the Centre will include an expansion to the Greenhouse as well as the replacement of one additional growth chamber.

E.L. Teske

S. Glover

Information and editorial services

Project Leader: E.L. Teske
Professionals: S. Glover
Support: L. Donk, P. C. Graham, L. Plummer, J. Wiens

Objectives

To provide the Centre with editorial and graphic services; to act as the channel through which contact is developed and maintained with the public, the forest community, national, regional and local news media, editors and printers; to produce booklets, news releases and to handle telephone and written enquiries.

Achievements

In support of ongoing programs at the Centre, staff provided editorial and graphic services; answered enquiries from clients; published three issues of "Information Forestry" newsletter; issued news releases, backgrounders and speeches; maintained contact with media; organized seminars and workshops; and published 30 journal articles, 29 contributions to symposium proceedings, 12 Information (technology transfer) reports, 23 miscellaneous reports and 24 FRDA research and/or socio-economic reports. Well in excess of 100,000 reports were distributed during the review period. A new electronic publishing system was installed

Public relations support was provided to the federal components of the Forest Resource Development Agreement (FRDA) through various grants and contributions to non-profit organizations. In particular, the British Columbia Forestry Association (BCFA) received funding to produce a weekly newspaper column "Ask About the Forest" and to produce material and distribute such to over 100 communities in British Columbia in promotion of National Forest Week. Funds were also provided to BCFA to establish an educational reference library and to produce and disseminate a publication list of available education materials on the forest resources and their management. Support was provided to the Truck Loggers Association to facilitate school tours at their annual general meeting and to the Festival of Forestry Society to stage tours of logging operations and forest management sites for school teachers. Four issues of "Renewal", the FRDA newsletter, were published.

In cooperation with the B.C. Ministry of Forests, under the cost-shared portion of the FRDA, 26 non-profit organizations throughout the province received $105,000 in funding to promote forest awareness/education activiites under the Green Gold Grants program. In addition, a major new mall display, featuring a talking tree and highlighting the accomplishments and achieve-

ments of FRDA, was developed and sent to 20 malls in B.C. communities. A series of regional brochures were written and distributed which focused on the economic and social benefits the FRDA programs have brought to the region. Some 20,000 copies of a full-colour 1989 calendar was produced and distributed. A spokesperson, former Chief Forester Bill Young, travelled to communities throughout B.C. to promote the benefits of the FRDA program to community leaders, opinion makers, media, etc.

Projections

To continue to promote activities and programs of Forestry Canada in the Pacific and Yukon region by providing graphic, editorial, public and media relations services. To cooperate with the provincial forest service to implement and deliver a communications program focussing on the F.R.D.A. and the South Moresby Forest Replacment Account. To launch a new magazine entitled "Woodland Review", aimed at providing private forest landowners with current information about forest management programs and services.

J. G. Skinner

L. Manning

A. Solyma

A. Van Niekerk

Planning and research support services

Project Leader: J. G. Skinner
Professionals: L. Manning, A. Solyma
Technician: A. Van Niekerk
Support: M. Mitchell

Objectives

To provide planning services to PFC Management; to provide research programs at PFC with inorganic chemical analysis services, light and electron microtechnique services, photographic services and comprehensive library information services; to provide technical and library support services for FRDA; and, to develop and refine techniques, skills and methodology as these diverse objectives require.

Achievements

Planning Services continued implementation of the integrated management information system for decision making and completed coordination of the 1988/89 work plan.

Chemical Services analyzed 15,300 units on 3036 samples of mineral soil, duff material, plant tissue, water and fertilizer from 16 PFC studies, several FRDA based PFC studies and co-operative studies with other Forestry Canada centres, as well as the private sector and the University of Victoria; participated in the co-operative education program of the University of Victoria; participated in the Forestry Canada laboratory quality control program; and, provided assistance to staff from other projects within PFC and BC Forest Service using the facilities of the laboratory; installed and calibrated a microwave digestion system designed to enhance soil dissolution.

Microtechnique Services were required by 20 PFC studies and involved SEM, TEM and light microscopy of wood, leaf, root and bud tissue; insect eggs, larvae, pupae and adults; fungal spores and hyphae; and bacteria. The microscopy laboratories also co-operated with and assisted two FRDA based studies funded by the British Columbia Forest Service, the Royal British Columbia Museum, the Department of National Defense, the Department of Agriculture, FPMI, and CIP. Several specific requests from local teachers and visiting tour groups were also accommodated. Scientific Photography Services were required by 5 studies since September/88 when this was added to the Microtechnique Service.

The purchase and installation of a Philips 301 Transmission Electron Microscope this year completed our comprehensive microscope facility and enabled all this work to be done "in house". A unique situation made a very

serviceable used TEM available through the British Columbia Health Department for an excellent price and we were pleased to be able to take advantage of this opportunity.

Library Services initiated Phase I of automation of library operations through implementation of the SYDNEY Integrated Library Management System with cataloging, circulation, and acquisitions insitu by year-end; options for acquiring records in machine readable format were tested and a plan was developed for cataloging operations and retrospective conversion; a test library database was developed; two AGRICOLA compact disc products for end-user searching were evaluated with a recommendation for purchase; responded to 480 requests for information where external sources had to be contacted; received 14,500 pieces of printed information; delivered requests for information through on-line database searches; Library clientele visits per month increased to 800 in 1988-89 from 670 in 1986-1987.

Projections

To continue to develop the regional component of Forestry Canada Management Information Reporting Systems.

Requisitions for inorganic chemical analysis are expected to total 20,000 units based on preliminary estimates. Improvements to the sample preparation rooms will be provided by the purchase and installation of a heavy duty electronic balance, drying trolley and shop vacuum.

Microtechnique and photography requests indicate a total of 65 weeks of services are required by 25 studies for SEM, TEM, light microscopy and photography.

To initiate Phase 2 of automation of library operations with an emphasis on data entry of new records and conversion of existing manual records to machine readable format; to implement end-user searching of the AGRICOLA database on compact disc; to acquire and implement the PROCITE software which researchers will use to manage their office reprint and report collections.

To continue to provide all these support services as required by the staff at PFC.

D. Say

S. Alers

G. Gondor

S. Moncrieff

Computing Services

Project Leader: D. Say
Professionals: S. Alers, G. Gondor, S. Moncrieff
Support: J. Foster

Objectives

To provide computing facilities, office automation support, information system development and support and electronic communications for PFC staff and to support program requirements.

Achievements

Computing Services continued to use its resources more effectively.

A tape cartridge backup system was installed and is now operating. All information on PFC's VAX is backed up to video cassette thus saving on storage and tapes and allowing unattended backups. Interest has been expressed in the backup software by other Forestry Canada centers.

Computer Services took advantage of discounts offered by DEC to lower their software maintenance contract by an 22%.

Computing Services developed a provisional implementation plan should PFC decide to purchase one or more high powered (SUN, APOLLO, DEC etc.) workstations.

PFC promotes the use of electronic mail where possible. Electronic communication increased 100 % over the 88/89 fiscal year. Computing Services arranged access to the BITNET network which will allow PFC to communicate with researchers at universities and other research establishments both in Canada and internationally.

PFC endeavors to gain efficiencies through process automation. Computer software was designed, developed and implemented for:

- A computer resource accounting system. This provides computer usage charges by individual, study, project and program.
- A quality verification and tape management information system. This allows the computer operator to check tape quality before assigning it to a user and keeps track of tape owners.
- A pension estimates program. This forecasts pension benefits for any user.

The most effective and efficient use of software packages comes through adequate training. The Office Systems Specialist provided refesher training, problem assistance, and usage tips to the 150 ALL-IN-1 users as well as training 10 new users. A review of spreadsheet software was undertaken in effort to consolidate on one package for the center. The Office Systems Specialist was trained in the chosen spreadsheet product. This person will provide

training to users at PFC in the efficient and effective use of the product.

Computer Services is also concerned with maintaining computer system and data integrity. Computer system security was tightened by the implementation of modem dial-back. This makes it virtually impossible for unauthorized people to dial-in to PFC's VAX.

The Virtual Microsystem was upgraded. The new equipment gives PFC nine standard IBM AT equivalents and three communicationports available to any user of the VAX. This equipment is used for software development as well as systems such as the Chemical Hazard Reporting and Information System and the Management Information and Planning System (MIPS).

Development continued on the Management Information and Planning System.

A mailing list application was designed, developed and implemented. This consolidated PFC's over 100 mailing lists into a single list. This list is now maintained by two individuals (part-time) instead of the 42 individuals previously. Interest has been expressed from FORCAN HQ in this package and they are supplying a summer student to assist in documenting the system.

Development and maintenance of the regional DEVMIS continued by implementing a new reporting structure for the DEVMIS data. Additional reports were created including variance between Provincial and Federal figures and FINCON and local records.

Support continued for information systems distributed by HQ and other departments of the Federal Government (HRIS, PASS, IMPS, and MMIS).

Projections

Introduce electronic versions of commonly used forms and explore the feasibility of future integration of these forms into management information systems.

Provide building-wide training in the CCALC spreadsheet product.

Changes made in the new version of ALL-IN-1 (v 2.3) will implement a partially automated Central Registry. Included in this will be a electronic spikefile for management based on All-in-1 shared folders.

Computing Services will investigate the possibility of enhancing electronic mail security.

Assist with the feasibility study of a workstation's integration into the PFC computing network.

Purchase additional computer hardware such as terminals, communications equipment and disks to provide enhanced support for all staff.

To continue to provide computing support services in the areas of computer operations, management information systems, computer system management, office systems and electronic communications to PFC staff.

Personnel Services

F.L. Scott

Personnel

Regional Personnel Manager: F.L. Scott
Staffing and Human Resources Officer: S. Robson
Compensation and Systems Supervisor: J.L. Rodway
Pay and Benefits Clerk: E.A. Avis

Objectives

To fullfill a dual role by assisting program management in carrying out human resource management functions and providing personnel services to employees in accordance with legislation, regulations, policy and procedures Personnel administration support is provided in pay and benefits, staffing, human resource planning, employment equity, training, classification, and staff relations. Personnel service and advice provided on a delegated and co-located basis to an average of approximately 200 indeterminate and term employees. There are 27 different groups represented within all occupational categories.

Achievements

Personnel management and accountability have been conducted in accordance with delegated authority and statutory and regulatory requirements. The roles of personnel staff have been adjusted to cope with an evolving and expanding program. Training has been completed for the new departmental Human Resource Information System which will be implemented during the 1989/90 fiscal year.

Automation continues to have a major impact upon activities. For example, all staffing letters and statements of qualifications are automated. A computerized pension estimate program has been developed that eliminates manual calculations; thus saving up to 75% of time required by personnel staff to action requests from staff for estimates. Other achievements include completion of a demographical analysis of PFC employee population and production of an employee orientation guide.

Projections

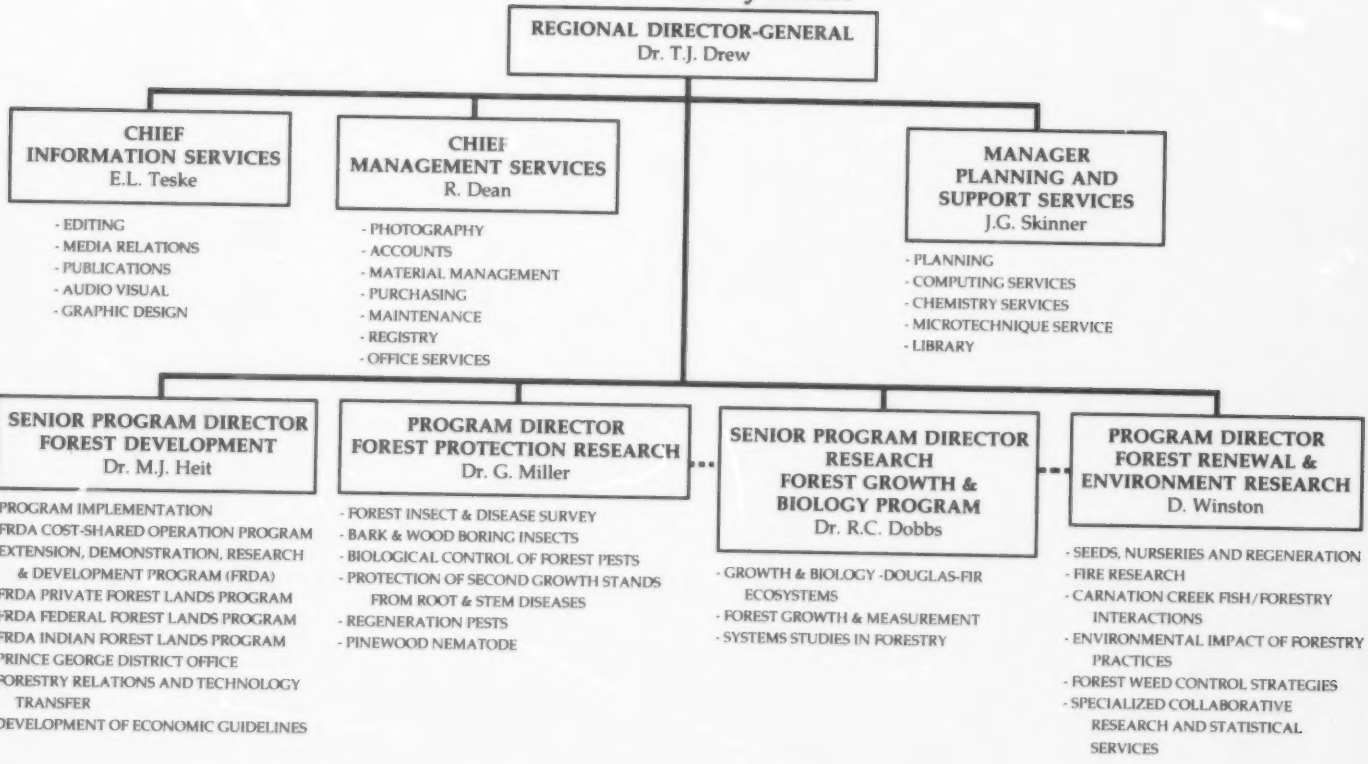
Personnel services and support will continue to be provided to employees and to research and development programs. The demand will continue to increase for advisory services, human resource planning activities, training and systems work. Benefits are anticipated in the future from new technology such as on-line pay, automated leave and attendance and further conversion of forms to electronic versions. Benefits include both the saving of staff time and the enhancement in levels of service. For example, work is underway to make the pension program more user friendly and when final testing is completed, staff will be able to access the program directly including a projecting feature.

Pacific Forestry Centre

1988-89 Expenditures

Program	Person Years	Salaries	O&M	Capital	Contributions	Total
Directorate	1.23	$43.2	$37.4	$0.0	$0.0	$80.6
Personnel	3.83	$117.7	$6.6	$3.5	$0.0	$127.8
Information	5.11	$199.6	$142.7	$64.0	$0.0	$406.3
Management Services	27.41	$858.6	$797.9	$420.4	$0.0	$2,076.9
Planning and Research Services	11.02	$471.0	$142.6	$173.3	$0.0	$786.9
Growth and Biology	20.93	$1,094.2	$160.2	$75.8	$0.0	$1,330.2
Protection	52.58	$2,495.1	$324.9	$86.1	$0.0	$2,906.1
Environment	30.37	$1,603.3	$161.3	$148.5	$0.0	$1,913.1
FRDA	16.02	$656.7	$1,507.2	$100.0	$37, 329.4	$39,593.3
Total	176.17	$8,070.6	$3,426.1	$1,071.6	$37,329.4	$49,897.7

Pacific Forestry Centre



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